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10/612,009	07/03/2003	Rieko Fukushima	7906.0018	5452

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EXAMINER	
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ART UNIT	PAPER NUMBER
2628	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/612,009	FUKUSHIMA ET AL.	
	Examiner	Art Unit	
	Daniel F. Hajnik	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 February 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *02 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 2, and 5 are rejected under 35 U.S.C. 102(b) as being anticipated by State et al. (NPL Document "Superior Augmented Reality Registration by Integrating Landmark Tracking and Magnetic Tracking", herein referred to as "State").

As per claim 1, State teaches the claimed:

> 1. A three-dimensional image display method comprising:
>
> detecting a position of a light source existing in real space;

By teaching of:

> **The (real) light source is tracked** (by the mechanical arm)
> (pg. 437, 3rd paragraph under section 8)
> (emphasis added to various quotations from the reference)

Here, the position of the light source is detected through the tracking of the mechanical arm.

State teaches the claimed:

> comparing the position of the light source and a virtual position of a display object in a three-dimensional image displayed in real space to obtain a relative positional relation therebetween;

By teaching of:

> Figure 8 demonstrates **a virtual object, a knot,** casting a shadow on a real object, a sculpture. The geometry of the

> sculpture was digitized with the mechanical arm and placed in the scene. **The (real) light source is tracked** (by the mechanical arm), and the **shadow map is calculated in real-time** (pg. 437, 3rd paragraph under section 8)
>
> A tracked light source moves real and virtual shadows in sync. (pg. 436, caption under figure 8)

Here, in order for the light source to cause virtual shadowing behind the three-dimensional image (where the displayed three dimensional image is the knot) the positions of both the light source and the object would have to be known. This is required in order to form the correct virtual shadows in response to the light cast from the light source and drawing the virtual shadowing caused by the three dimensional object (also see figure 8 where this is shown).

State teaches the claimed:

> shading in the three-dimensional image

By teaching of:

> Figure 9 shows a similar scene. The knot intersects the real objects, emphasizing the accurate registration of **the synthetic imagery (the knot and its shadow)** with the real cuboids. (pg. 437, 3rd paragraph under section 8)

Here, figure 9 shows shading on the three-dimensional image itself (where the three dimensional image is the knot).

As per claim 2, State teaches the claimed:

> 2. The method according to claim 1, further comprising: detecting lightness of the light source.

By teaching of:

> CCD video cameras ... attached to the HMD (pg. 430, 1st paragraph under section 4)

> The second component of the landmark finder is the **image analyzer**, which starts its search for a landmark by **inspecting the search area** defined by the landmark predictor.
> (pg. 432, 1st paragraph under section 6.2.2)
>
> For our specific camera and frame grabber hardware, and **under the lighting conditions in our lab, such a simple algorithm can reliably distinguish between only a small number of different colors**
> (pg. 432, 2nd paragraph under section 6.2.2)

Here, by inspecting a search area using an image analyzer, the lightness is detected as indicated in the reference where different colors are detected. Since some colors appear darker or lighter than others the lightness is detected in this analysis.

As per claim 5, this claim is similar in scope to claim 1, and is rejected under the same rationale.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 6-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over State.

As per claim 6, the reasons and rationale for the rejection of claim 1 is incorporated herein.

State does not explicitly teach the claimed:

> a plurality of detectors which detects a position of a light source existing in real space;

However, State suggests the claimed limitation by teaching of in figure 6 of two detectors (cameras labeled c1 and c2) used to calculate a position of a landmark. It would have been obvious to one of ordinary skill in the art to incorporated this position detection method using multiple detectors to detect a position of a light source as well. The modification can be achieved by replacing the landmark labeled (L2) in figure 6 with a light source, and using detectors c1 and c2 to detect the light source position. One advantage to such a modification is to allow for a more freely controlled light source, which is not constrained by a mechanical arm for position detection, by utilizing a plurality of detectors to detect the light source position.

As per claims 7 and 8, State teaches the claimed:

> a display surface configured to display the three-dimensional image

By teaching of:

> Head-Mounted Displays (HMDs)
> (pg. 429, 1st paragraph under section 1)

Here, the head-mounted display has an associated display surface or surfaces near the eyes that produce the three-dimensional image for the user to view.

State does not explicitly teach the claimed:

> the detector is disposed on at least one of the display surface and a surface adjacent to the display surface.
>
> the detector is disposed to be adjacent to the display surface.

However, States suggests the claimed limitations by teaching of:

> CCD video cameras ... attached to the HMD

(pg. 430, 1st paragraph under section 4)

Here, the video cameras are located adjacent to the display and are capable of detecting of light. It would have been obvious to one of ordinary skill in the art to achieve the claimed limitation by utilizing the CCD video cameras as light position detectors which are adjacent to the display surface. The reference suggests this use of the CCD video cameras for light position detection in figure 6 where cameras C1 and C2 are used to detect the position of landmark L2. The motivation of claim 6 is incorporated herein.

As per claim 9, State does not explicitly teach the claimed:

> 9. The device according to claim 5, wherein the detector is disposed at a position where the detector detects the
> light emitted from the light source located in the same direction as at least one of a display direction of the three dimensional image and a direction in which the three-dimensional image is observed

However, State suggests the claimed limitation by teaching of:

> Head-Mounted Displays (HMDs)
> (pg. 429, 1st paragraph under section 1)
>
> CCD video cameras ... attached to the HMD
> (pg. 430, 1st paragraph under section 4)

where the HMD display displays the three-dimensional image in a direction in front of the user's eyes. It would have been obvious to one of ordinary skill in the art to achieve the claimed limitations by using the camera as a light position detector instead of the mechanical arm to achieve the claimed limitations. The modification can be achieved by using the two cameras (detectors) mounted on the head mounted display to detect the position of the light source. The result of this modification is that the light will be detected in the same direction as the display

direction of the three-dimensional image since the head mounted display displays the image and because the cameras (detectors) are mounted on the head mounted display. The motivation of claim 6 is incorporated herein.

As per claim 10, State does not explicitly teach the claimed:

> 10. The device according to claim 5, wherein:
> the detector includes three-primary colors detection unit that adds colors to the shade.

State suggests the claimed limitation by teaching of:

> RGB component values ... distinguish between only a small number of different colors
> (pg. 432, 2nd paragraph under section 6.2.2)

Further, State suggests of adding colors to the shade in figure 9 where a shadow is added over top of the yellow colored circular mark and the colors are mixed. Thus, it would have been obvious to one of ordinary skill in the art to achieve the claimed limitations by using the camera as a light position detector instead of the mechanical arm. The modification can be achieved by using the two cameras (detectors) mounted on the head mounted display to detect the position of the light source and thus also detect the three-primary colors. The modification is possible because the reference states the cameras are capable of detecting three-primary colors. The motivation of claim 6 is incorporated herein.

5. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over State in view of Drettakis et al. (NPL Document "Interactive Common Illumination for Computer Augmented Reality", herein referred to as "Drettakis").

As per claim 3, the reasons and rationale for the rejection of claim 1 is incorporated herein. State does not explicitly teach the claimed:

> detecting positions of a plurality of light sources existing in real space;

Drettakis teaches the claimed limitation by teaching of:

> We have introduced a new framework for dealing with the problem of common illumination between real and synthetic objects and **light sources** in the context of computer augmented reality.
> (1st paragraph under section 6.3)

> We have briefly discussed some possible future research paths, by removing the restrictions one by one, to achieve **interactive common illumination** for first a moving camera, then **moving lights** and finally moving real objects.
> (3rd paragraph under section 6.3)

Here, in order to achieve interactive illumination with a CG object the positions of the plurality of light sources must be known in order to correctly add the realistic shadows effects. Without knowing the positions of the light sources the shadow effects can look unrealistic. Thus, the system detects a plurality of light source positions.

It would have been obvious to one of ordinary skill in the art at the time of invention to combine State and Drettakis. Drettakis teaches one advantage of the combination by teaching of:

> Novel advances in computer vision are **used for camera calibration and user-friendly modeling** of the real scene, a recent interactive radiosity update algorithm is adapted to provide **fast illumination update** and finally textured polygons are used for display. This approach allows interactive update rates on mid-range graphics workstations. Our new framework will

> hopefully lead to CAR systems with **interactive common illumination without restrictions** on the movement of real or synthetic objects, lights and cameras. (abstract)

where State would benefit from the added functionality.

As per claim 4, State does not explicitly teach the claimed:

> 4. The method according to claim 3, further comprising:
>
> obtaining a position of a single virtual light source, which represents the plurality of light sources; and

Drettakis teaches the claimed limitation by teaching of:

> In the system presented we have not shown **the addition of virtual lights**. This is not too hard to achieve, but requires some modification to the incremental update approach, since **the addition of a light source typically affects a large part of the environment**. In addition, special attention must be taken in the re-scaling of the image before display since the addition of **a source can add an order (or orders) of magnitude to the radiosity values of the scene**
> (col 4, lines 10-12)

Here, the single virtual light source can be represented as the accumulation of radiosity. The reference refers to "adding" light onto the total radiosity for each light source. When every light source is considered, one can represent this radiosity as a single virtual light source through the addition of all individual light sources.

State does not teach the claimed:

> comparing the position of the virtual light source and the virtual position of the display object in the three-dimensional image to obtain the relative positional relations therebetween.

Drettakis teaches the claimed limitation in figures 3 and 4. Figure 4 shows the result of the comparison between the virtual light source (as calculated as the accumulated radiosity in figure

3) and the virtual position of the display object (the floating box above the desk). The comparison of the positions and relative positional relationship result in the rendering of a soft and varying shadow on the desk below the floating object. The varying nature of this shadow can be due to the plurality of light directional components provide by the virtual light source. One advantage to using this claimed feature with State is to achieve realistic soft shadows affects utilizing multiple light sources.

Response to Arguments

1. Applicant's arguments filed 2/27/2007 have been fully considered but they are not persuasive.

Applicant argues State fails to teach the claimed comparing the position of the light source and a virtual position of a display object in a three-dimensional image displayed in real space (middle of page 3 in filed response) and argues the sculpture cannot constitute a three dimensional image displayed in real space because the sculpture is not an image and that is not displayed (top of page 4 in filed response)

The examiner respectfully maintains that the rejections are proper because in figure 8 on page 436 of State shows a virtual object that is displayed in real space, the knot. In this figure, the sculpture is an actual real object and thus is not displayed. The examiner is not intending to rely upon the sculpture as a displayed image. Further, in this figure, the knot is floating in mid air to emphasis that it is a virtual object, which is displayed through the head mounted display (HMD). Further, the knot casts a shadow on real objects in the scene and has shading on itself based upon a real light source (the actual light is not shown but would be located to the left of the scene).

Further, since the shadows cast are a displayed virtual object, the shadows themselves can also be considered virtual or displayed images. In this instance, the virtual objects such as the knot are displayed on the HMD display, and yet to the user appear as displayed in real space. The claim language requires "a virtual position of a display object in a three-dimensional image displayed in real space". This phrase is taught by State where the user wearing a HMD with see a virtual position of the floating knot in three-dimensional image as displayed in real space according to the output shown in figure 8.

Applicant further argues that the objects shaded in the HMD are not objects shaded in real space because the HMD provides shading only to objects as displayed on the HMD (middle of page 4 in filed response).

The examiner respectfully maintains that the rejections are proper because based upon the output in figure 8 the user would view the output shaded as shading appearing in real space. The user wearing the HMD display gives the illusion that the floating knot would create a shadow and thus would appear to be shading in real space. For example, with the tracking technology, the user wearing the HMD could move about the area and interact with objects in real space and still see the displayed shading created by the knot. Thus, under this interpretation of the claim language the shading and display object can be both a display object on the three-dimensional image (as claimed in claim 1, for example) and "displayed in real space" (also claimed in claim 1) because the HMD makes this displaying possible.

Conclusion

2. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Daniel F. Hajnik whose telephone number is (571) 272-7642. The examiner can normally be reached on Mon-Fri (8:30A-5:00P).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ulka J. Chauhan can be reached on (571) 272-7782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

D. H. 5/10/07

DFH

ULKA J. CHAUHAN
PRIMARY EXAMINER